RISK BASED INSPECTION PRIORITIES

by

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Risk based inspection

JLARC

- Joint Legislative Audit and Review Committee
- Oversight and review of Washington's Pipeline Safety Office – May 15, 2003
- Recommendation 1: *WUTC should develop an inspection strategy to focus specifically on risks of failure in Washington's pipelines, rather than on numbers of FTE's or inspections*

Why risk based inspection?

- OPS Expectations
- JLARC
- It makes sense

Addressing risks

- Develop comprehensive understanding of pipeline risk
- Develop comprehensive understanding of mitigation measures
- Develop comprehensive understanding of operator character
- Carry out program activities in accordance with risk based inspection priorities

Risk based inspections

- Take factors into account that contribute to risk
- Give credit for strong mitigation measures
- Apply specifically to the operator
- Higher risk operators should be inspected more
- Risk assessment is the tool to manage risks

Risk Assessment

- Rank facilities according to relative risk
- Lower risk scores are applied companies that exceed regulatory standards
- Set inspection priorities
- Accuracy
- Improve safety

Relative risk assessment

- Quantitative Weighting
- Higher Score = Higher Risk
- Add risk $\Rightarrow$ Add to score
- Regulatory vs non regulatory

Risk contributing factors

- 1. Spills/releases
- 2. Near Misses/Safety Related Conditions
- 3. Violations
- 4. Items of Concern
- 5. Last Inspection
- 6. High Consequence Areas

Risk contributing factors (cont)

- 7. Pipe Characteristics
- 8. Operations and Maintenance
- 9. Integrity Management
- 10. Human Factors
- 11. Natural Factors
- 12. Management

Point distribution

- Spills/leaks 200
- Near Misses/Safety Related Conditions 100
- Violations 75
- Items of Concern 25
- Last Inspection 75x # years
- High Consequence Areas 75

Point distribution (cont)

Pipe Characteristics	50
Operations and Maintenance	60
Integrity Management	100
Human Factors	50
Natural Factors	75
Management	100

Spills/releases

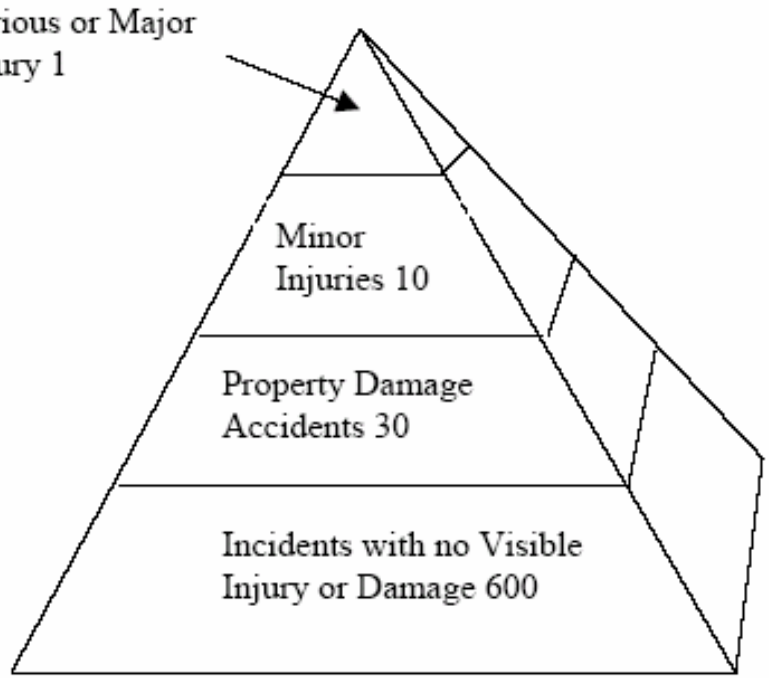
Conditions	Points
Within previous year: 1 Federally reportable incident or >5 state reportable incidents	200
2 years or less since federally reported incident, a state reported incident within the year or less	100
3 years since a federally reported incident, 2-3 years since state reported incident	75

Spills/Leaks Cont.

4-5 years since federally reported incident, 4-5 years since state reported incident	50
A federal or state reported incident within 10 years	25
No reported incident for >10 years	0

Near Misses/Safety Related Conditions

EXHIBIT 3
Safety Pyramid with 1969 US Ratio Study



Near Misses/Safety Related Conditions

Condition	Points
> 24 deferred leaks	70
>17 – 24 deferred leaks	60
> 9 – 17 deferred leaks	50
>4 – 9 deferred leaks	25
1-4 deferred leaks	15
0 leaks	0
Each safety related condition	Add 10 per

Violations

Condition	Points
> 7 violations during last standard inspection	75
7 violations during last standard inspection	70
6 violations during last standard inspection	60
5 violations during last standard inspection	50
4 violations during last standard inspection	40

Violations (cont)

Conditions	Points
3 violations during last standard inspection	30
2 violations during last standard inspection	20
1 violation during last standard inspection	10
0 violations during last standard inspection	0

Items of Concern

Condition	Points
> 4 items of concern during last standard inspection	25
4 items of concern during last standard inspection	20
3 items of concern during last standard inspection	15

Items of Concern (cont)

Condition	points
2 items of concern during last standard inspection	10
1 item of concern during last standard inspection	5
0 items of concern during last standard inspection	0

High Consequence Areas

Condition	Points
> 50 miles in a high consequence area	75
40 - < 50 miles in a high consequence area	70
30 - < 40 miles in a high consequence area	60
20 - < 30 miles in a high consequence area	50
10 - < 20 miles in a high consequence area	40

High Consequence Area (cont)

Condition	points
5 - < 10 miles in a high consequence area	30
1 - < 5 miles in a high consequence area	20
< 1 mile in a high consequence area	10
0 miles in a high consequence area	0

Last Inspection

Condition	Points
5 - < 6 years since WUTC inspection	375
4 - < 5 years since WUTC inspection	300
3 - < 4 years since WUTC inspection	225
2 - < 3 years since WUTC inspection	150
1 - < 2 years since WUTC inspection	75
< 1 year since WUTC inspection	0

Pipe Characteristics

Condition	Cumulative Points
System Safety Factor	20
Fatigue	10
Toughness	5
Long Seam	5
Weld Quality	5
Records	5

Pipe Characteristics
System Safety Factor

- System Safety Factor = (OP/MAOP) x 20
  - OP = Operating Pressure (psig)
  - MAOP = Maximum Allowable Operating Pressure (psig)
- Highest scored segment is used in assessment

Pipe Characteristics- Fatigue

Maximum Stress/Minimum Stress	# cycles		
	< 1,000	1,000 – 1,000,000	> 1,000,000
<.2	5	8	10
>.2 - .4	4	7	9
>.4 - .6	3	6	8
> .6 - .8	2	5	7
> .8 - .9	1	4	6
> .9 -1.0	0	3	5

Pipe Characteristics- Toughness

- 5 points if:
  - Carbon content > 0.25%
  - Sulfur content > 0.015% and,
  - Phosphorus > 0.01%

Pipe Characteristics- Long Seam

- Long Seam Score =
  - (% pipe with Pre-1978 low frequency welded seam x 3) +
  - 2 (if there is a history of seam failures in-service or during hydro test)

Pipe Characteristics
Weld Quality

- Weld quality score =
  - (% welds not radiographed x 2) +
  - Weld history points

Pipe Characteristics
Weld History

Condition	Points
Weld failures during hydro test or in-service	3
No weld failures	0

Pipe Characteristics- Records

Condition	Cumulative Points
No weld inspection records for any welds	2
Missing pipe specification records	2
Missing Appurtenance records	1
Have records for all the above	0

Operations and Maintenance

Condition	Cumulative points
Damage Prevention	20
Preventative Maintenance	10
Pressure Control	10
Leak Minimization	10
O&M Inspection	10

Operations and Maintenance Damage Prevention

Condition	Points
> 25 third party hits / year	20
Between 17 and 24 third party hits / year	15
Between 10 and 16 third party hits / year	10
Between 1 and 10 third party hits / year	5
No third party hits / year	0

Operations and Maintenance Preventative Maintenance

Condition	Cumulative Points
No post startup review for new or modified components	2
No established operating parameters	1
No monitoring of established operating parameters	1

Operations and Maintenance Preventative Maintenance (cont)

Condition (cont)	Cumulative points (cont)
No testing for out of service equipment	2
No testing and maintenance of protective systems	2
No QA/QC program for equipment replacement	2

Operations and Maintenance Pressure Control

Condition	Cumulative Points
No high pressure alarms located at attended stations	3
No continuous monitoring of line pressures at manned stations	2
Regulator / relief's are not set below MAOP/ MOP by > 10%	5

Operations and Maintenance Release Minimization

Condition	Points
Release from any location can be stopped in over an hour	10
Release from any location can be stopped between 45 minutes and an hour	7
Release from any location can be stopped between 30 minutes and 45 minutes	5

Operations and Maintenance Release Minimization (cont)

Condition (cont)	points
Release from any location can be stopped between 15 minutes and 30 minutes	3
Release from any location can be stopped in under 15 minutes	0

Operations and Maintenance
O & M Inspection

Violations/NOA/items of Concern	points
> 10 items	10
9 items	9
8 items	8
7 items	7
6 items	6

Operations and Maintenance
O & M Inspection (cont)

Violation/NOA/items of concern (cont)	points
5 items	5
4 items	4
3 items	3
2 items	2
1 items	1

Integrity Management

Condition	Cumulative Points
Integrity Management Inspection	50
Repairs	50

Integrity Management Inspection

- Integrity Management Inspection Score =
  - Violation Score + Notice of Amendment (Item of Concern Score)

Integrity Management Inspection

Violations	Points
> 7 Violations	40
7 violations	35
6 violations	30
5 violations	25

Integrity Management Inspection

Violations	points
4 violations	20
3 violations	15
2 violations	10
1 violation	5
0 violations	0

Integrity Management Inspection

NOA/IOC items	points
> 5 NOA/IOC items	10
4 NOA/IOC items	8
3 NOA/IOC items	6
2 NOA/IOC items	4
1 NOA/IOC items	2
0 NOA/IOC items	0

Integrity Management- Repairs

- Repair score =
  - Corrosion score +
  - Dent Score +
  - Gouge Score +
  - SCC Score

Integrity Management-Repairs

- Corrosion Score =
  - External Corrosion +
  - Internal Corrosion +
  - Atmospheric Corrosion

Integrity Management
External Corrosion

Condition	Points
Any general corrosion or pits ≥ 50% w.t.	10
Any general corrosion or pits between 40 % and 50 % w.t.	8
Any general corrosion or pits between 30% and 40% w.t.	6

Integrity Management External Corrosion (cont)

Condition	points
Any general corrosion or pits between 20 % and 30 % w.t.	4
Any general corrosion or pits between 10 % and 20 % w.t.	3
Any general corrosion or pits < 10% w.t.	2
No pits or general corrosion	0

Integrity Management
Internal Corrosion

Condition	Cumulative points
Any instance of internal corrosion detected	4
No in-line monitoring for internal corrosion within past 5 years	1

Integrity Management Atmospheric Corrosion

Condition	points
Pitting	5
Heavy rust	4
Moderate rust	3
Minor rust	2
Some coating deterioration-no rust	1
Good coating	0

Integrity Management-Dents

Condition	points
Dents > 2%	10
Dents between 1% and 2%	7
Dents < 1%	3
No dents	0

Integrity Management-Gouges

Condition	points
Gouges > 12.5 %	10
Gouges between 5 % and 12.5 %	7
Gouges between 0 and 5 %	3
No gouges	0

Integrity Management-SCC

Condition	Cumulative points
History	4
Testing	3
Conditions	3

Integrity Management
SCC - History

Condition	Cumulative Points
Instances of SCC on system	4
No SCC ever detected on system	0

Integrity Management
SCC - Testing

Condition	Points
No appropriate hydro testing or crack detection tool run	3
Appropriate hydro testing or crack detection tool run	0

Integrity Management
SCC- Conditions

Condition	Cumulative Points
Pipeline Operates at > 40 % SMYS	2
Tape or coal tar coating used	1

Human Factors

Condition	Cumulative Points
Operator Qualifications	30
Knowledge and Skill Training	10
Drug and Alcohol	10

Human Factors
Operator Qualifications

- Operator Qualification Score =
  - Violation score +
  - Items of concern score

Human Factors
Operator Qualifications

Violations	Points
> 4 violations	25
4 violations	20
3 violations	15
2 violations	10
1 violation	5
0 violations	0

Human Factors
Operator Qualifications

Items of Concern	Points
> 4 items of concern	5
4 items of concern	4
3 items of concern	3
2 items of concern	2
1 item of concern	1
0 items of concern	0

Human Factors Training

Condition	Cumulative Points
No training and needs analysis	2
No instructor qualifications	2
No training systems	2
No training system evaluation and follow-up	4

Human Factors
Drug and Alcohol

- Drug and Alcohol score =
  - Violation score +
  - Item of concern score

Human Factors
Drug and Alcohol

Violations	points
> 6 violations	7
6 violations	6
5 violations	5
4 violations	4
3 violations	3
2 violations	2
1 violation	1
0 violations	0

Human Factors
Drug and Alcohol

Items of Concern	Points
> 4 items of concern	3
3-4 item of concern	2
1-2 item of concern	1
0 items of concern	0

Natural Factors

Condition	Cumulative Points
Landslide	40
Earthquake	20
Flooding	10
Lightning	5

Natural Factors
Landslides

- Landslide score =
  - Landslide index –
  - (50% maximum deduction for comprehensive program)

Natural Factors
Landslide Index

Condition	points
≥ 15 miles pipe in landslide zone	40
≥ 10 and < 15 miles in landslide zone	30
≥ 5 and < 10 miles in landslide zone	20
> 0 and < 5 miles in landslide zone	10
0 miles in landslide zone	0

Natural Factors
Landslide

- Elements of Comprehensive Landslide Plan
  - Landslide recognition training
  - Geotechnical studies completed
  - Regular evaluation of priority slides
  - Regular over flights (pilot trained)
  - Additional monitoring during wet periods
  - Stress/Strain gauges monitored
  - Other monitoring (i.e. inclinometer, piezometer)
  - Remote operated valves for high risk areas
  - Line stress relief criteria established and implemented
  - Remote monitoring at high risk locations

Natural Factors
Landslides

Condition	Point deduction
Perform 9 elements	50%
Perform 8 elements	40%
Perform 6-7 elements	30%
Perform 4-5 elements	20%
Perform 1-3 elements	10%
Do not perform any elements	0%

Natural Factors
Earthquake

- Earthquake score =
  - Earthquake zone score +
  - Liquefaction score –
  - 25% for comprehensive earthquake plan

Natural Factors
Earthquake zones

Condition	points
High zone	10
Medium zone	7
Low zone	3

Natural Factors
Liquefaction

Condition	points
> 25 miles in high liquefaction zone	10
> 10 miles in high liquefaction zone or > 25 miles in moderate liquefaction zone	8
> 5 miles in high liquefaction zone or 10 miles in moderate liquefaction zone	6

Natural Factors
Liquefaction (cont)

Condition (cont)	points
> 0 miles in high liquefaction zone or 5 miles in moderate liquefaction zone	4
> 0 miles in moderate liquefaction zone	2
0 miles in high or moderate liquefaction zones	0

Natural Factors
Earthquake

- Elements of comprehensive earthquake plan
  - Training on plan
  - Strong motion instrumentation
  - Geotechnical study completed
  - Stress/strain gauges installed and monitored
  - Shutoff criteria established
  - Leak testing prior to restart
  - Over flight prior to restart
  - Remote valves at high risk locations

Natural Factors
Earthquakes

Condition	Point deduction
Perform 7 elements	25%
Perform 6 elements	20%
Perform 5 elements	15%
Perform 3-4 elements	10%
Perform 1-2 elements	5%
Do not perform any elements	0%

Natural Factors
Flooding

Condition	points
≥ 10 miles pipe in flood zone	10
Between 5 & 10 miles in flood zone	6
Between 0 & 5 miles in flood zone	3
0 miles in flood zone	0

Natural Factors
Lightning

- Lightning score =
  - % of facilities w/o lightning protection x 5

Management

Conditions	points
Leadership and Administration	10
Leadership training	5
Planned inspections and maintenance	5
Critical task analysis and procedures	5
Engineering and management of change	5
Incident investigations	5
Task observation	4

Management (cont)

Condition (cont)	points
Emergency preparedness	5
Rules and work permits	4
Incident analysis	5
Personal protective equipment	4
Health or hygiene control	5
System evaluation	5
Personal communication	5

Management (cont)

Condition (cont)	points
Group communication	5
General promotion	5
Materials and service management	4
Off the job safety	4
Environmental management	5
Quality management	5

Management
Leadership and Administration

Condition	Cumulative Points
General policy statement	1
Loss control coordinator qualifications	1
Senior management and middle management participation in loss control activities	1
Loss control standards for all personnel	1

Management-Leadership and Administration (cont)

Condition (cont)	Cumulative points
Loss control reference manual	1
Annual loss control objectives established	1
Joint safety and health committees and or/or representatives	1

Management-Leadership and Administration (cont)

Condition	Cumulative points
Policy on refusal to work due to work hazards	1
Applicable regulations, codes, and standards identified	1
Communication with external parties	1

Management Leadership training

Condition	Cumulative points
Training needs analysis	1
Loss control orientation for new leaders/managers	1
Loss control training of senior management/managers/leaders	1

Management
Leadership training (cont)

Condition (cont)	Cumulative points
Update loss control training for senior management/ managers/ leaders	1
Formal training of loss control coordinator	1

Management-Planned inspections and maintenance

Condition	Cumulative points
Planned inspections	1
Critical parts, preventative maintenance and special systems inspected	1
Follow up inspections	1

Management -Planned inspections and maintenance (cont)

Conditions (cont)	Cumulative points
Pre-use equipment inspections	1
System for employees to report substandard conditions in writing	1

Management-Critical task analysis and procedures

Condition	Cumulative points
Task analysis system installed	1
Critical tasks identified	1
Controls developed for potential losses	1

Management-Critical task analysis and procedures (cont)

Condition (cont)	Cumulative points
Controls incorporated into procedures and practices	1
Critical task procedures /practices updated	1

Management
Incident investigations

Conditions	Cumulative points
Incident investigation system	1
Operating management participation	1
Review of major and high potential accidents / incidents	1

Management
Incident investigations (cont)

Condition (cont)	Cumulative points
Remedial actions and follow up	1
Near miss reporting and investigations	1

Management-Task observation

Condition	Cumulative points
System for partial / spot task observations	1
Systems for complete task observation	1
Critical task observation performed	1
Follow up system	1

Management
Emergency Preparedness

Condition	Cumulative points
Identification of potential emergencies	1
Source of energy controls	1
Emergency team	1
First aid	1
Organized help and / or mutual aid	1

Management
Rules and work permits

Condition	Cumulative points
General loss control rules	1
Specialized work rules and specialized work permits	1
Rule education and review	1
Rule compliance and recognition	1

Management
Personal protective equipment

Condition	Cumulative points
Identification of personal protective needs	1
Personal protective equipment available	1
Personal protective equipment training	1
Enforcement of standards	1

Management-Incident analysis

Condition	Cumulative points
Consequence measurements	1
Cause and control analysis	1
Property damage, process loss identification and analysis	1
Near miss analysis	1
Problem solving project teams	1

Management
Health and hygiene control

Condition	Cumulative points
Health hazard identification and evaluation	1
Health hazard control and monitoring	1
Information and training	1
Ergonomic program with assistance	1
Internal communications	1

Management-System evaluation

Condition	Cumulative points
Assessment of loss control requirements	1
Regular loss control system monitoring	1
Evaluation of compliance with loss management system standards	1

Management
System evaluation (cont)

Condition (cont)	Cumulative points
Employee perception surveys	1
Coordination of loss management strategies	1

Management-Engineering and change management

Condition	Cumulative points
Hazard evaluation and risk assessment	1
Project review and change management	2
Operational and work process change management	2

Management
Personal communications

Condition	Cumulative points
Training in personal communication techniques	1
Individual job orientation	1
Task instruction	1
Planned personal contacts	2

Management
Group communications

Condition	Cumulative points
Quantity and quality of group meetings	2
Management involvement	3

Management-General promotion

Conditions	Cumulative points
Loss control bulletin	1
Use of incident statistics	1
Critical topic promotion	1
Award or recognition	1
Loss control information publications	1

Management-Materials and services management

Condition	Cumulative points
Procurement of goods	1
Contractor selection	1
Management of contracts	2

Management-Off the job safety

Condition	Cumulative points
Problem identification and analysis	1
Off the job safety education	1
External loss control communications	2

Management
Environmental management

Conditions	Cumulative points
Environmental policy	1
Top management involvement in environmental issues	1
Environmental goals	1
Environmental training	1
Environmental incentives	1

Management
Quality management

Condition	Cumulative points
Quality policy	1
Top management involvement in quality issues	1
Quality goals	1
Quality training	1
Quality incentives	1

Conclusion

- A work in progress
- Work group participation
- Inspections frequency will be impacted